CLAIMS

What is claimed is:

1. A material having an interconnected pore structure, comprising:

a viscous component; and

a plurality of biodegradable inclusions, wherein the inclusions comprise polymers.

2. The material of claim 1, wherein the viscous component comprises at least one material selected from the group consisting of PLGA, PLLA, PGA, and PCL.

3. The material of claim 1, wherein the polymers are cross-linked.

4. The material of claim 3, wherein the polymers are cross-linked by exposure to thermal, photo, or chemical agents.

5. The material of claim 1, wherein the inclusions have a shape comprising a three-dimensional star.

6. The material of claim 1, wherein the inclusions have a surface to volume ratio of greater than six times the unit edge of a bounding box.

7. A bone replacement material comprising:

a viscous component; and

a plurality of biodegradable inclusions, wherein the inclusions comprise polymers.

8. The bone replacement material of claim 7, wherein the viscous component comprises an aqueous-based composition or a polymer.

9. The bone replacement material of claim 8, wherein the aqueous-based composition comprises an aqueous lubricant and a calcium source.

10. The bone replacement material of claim 9, wherein the aqueous lubricant comprises at least one lubricant selected from the group consisting of saline solution, drug solution, PBS, and pure water.

11. The bone replacement material of claim 9, wherein the calcium source comprises at least one source selected from the group consisting of calcium phosphate, $CaCo_3$, CaOH, CaO, $CaNO_3$, $CaCl_2$, CaF_2, Ca alginates, and hydroxyappatite.

12. The bone replacement material of claim 8, wherein the polymer comprises at least one polymer selected from the group consisting of poly(l-lactic acid), poly(d l-lactic acid), poly(glycolic acid), poly(lactic-co-glycolic acid), poly(paradioxanone), poly(dl-glycolic acid), poly(propylene fumarate), oligo (PEG fumerate), poly(ethyleneglycol), poly(caprolactone), poly(hydroxybutyrate), poly(hydroxy valerate), poly(SA-HDA anhydride), poly(orthoesters), poly(phosphazenes), and copolymers of dl-lactic acid and dl-glycolic acid.

13. The bone replacement material of claim 7, wherein the inclusions have an engineered shape.

14. The bone replacement material of claim 7, wherein the inclusions comprise at least one polymer selected from the group consisting of poly(paradioxanone), poly(dl-lactic acid), poly(dl-glycolic acid), poly(propylene fumarate), oligo (PEG fumerate) copolymers of dl-lactic acid and dl-glycolic acid, and mixtures thereof.

15. The bone replacement material of claim 7, wherein the polymers are cross-linked.

16. The bone replacement material of claim 15, wherein the polymers are cross-linked by exposure to thermal, photo, or chemical agents.

17. The bone replacement material of claim 7, wherein the viscous component comprises a polymer, and wherein at least one of the inclusions comprises the same polymer.

18. The bone replacement material of claim 7, wherein the inclusions comprise more than 30 vol. % of the bone replacement material.

19. The bone replacement material of claim 7, wherein the inclusions have a shape comprising a three-dimensional star.

20. The bone replacement material of claim 7, wherein the inclusions have a surface to volume ratio of greater than six times the unit edge length of a bounding box.

21. The bone replacement material of claim 7, wherein the inclusions have an aspect ratio greater than 1.

22. The bone replacement material of claim 7, wherein the inclusions are constructed by at least one technique selected from the group consisting of stereo-lithography, photo-lithography, stamping techniques, three-dimensional printing, extrusion, and fused deposition modeling.

23. The bone replacement material of claim 7, wherein all of the inclusions are in contact with at least one other inclusion.

24. The bone replacement material of claim 7, wherein the inclusions comprise a predetermined biodegradation rate.

25. The bone replacement material of claim 7, wherein the bone replacement material further comprises at least one therapeutic agent.

26. The bone replacement material of claim 7, wherein the bone replacement material has a compressive strength of at least about 20 Mpa.

27. The bone replacement material of claim 7, wherein the bone replacement material has between about 30 and 80 percent porosity.

28. A method for creating a bone replacement material, wherein the bone replacement material comprises a composite material, comprising:

(A) providing a viscous component;

(B) providing a plurality of biodegradable inclusions, wherein the inclusions comprise polymers; and

(C) combining the viscous component and the plurality of inclusions to produce the bone replacement material.

29. The method of claim 28, wherein the viscous component comprises an aqueous-based composition or a polymer.

30. The method of claim 29, wherein the polymer comprises at least one polymer selected from the group consisting of poly(l-lactic acid), poly(d l-lactic acid), poly(glycolic acid), poly(lactic-co-glycolic acid), poly(paradioxanone), poly(dl-glycolic acid), poly(propylene fumarate), oligo (PEG fumerate), poly(ethyleneglycol), poly(caprolactone), poly(hydroxybutyrate), poly(hydroxy valerate), poly(SA-HDA anhydride), poly(orthoesters), poly(phosphazenes), and copolymers of dl-lactic acid and dl-glycolic acid.

31. The method of claim 28, wherein the inclusions comprise at least one polymer selected from the group consisting of poly(paradioxanone), poly(dl-lactic acid), poly(dl-glycolic acid), poly(propylene fumarate), oligo (PEG fumerate), copolymers of dl-lactic acid and dl-glycolic acid, and mixtures thereof.

32. The method of claim 28, wherein step (B) further comprises constructing the inclusions.

33. The method of claim 32, wherein the inclusions are constructed by at least one technique selected from the group consisting of stereo-lithography, photo-lithography, stamping techniques, three-dimensional printing, extrusion, or fused deposition modeling.

34. The method of claim 28, further comprising:

(D) curing the bone replacement material.

35. The method of claim 34, further comprising

(E) removing the inclusions.

36. The method of claim 35, wherein the inclusions are removed by biodegradation.

37. The method of claim 34, wherein the bone replacement material has a compressive strength of at least about 20 MPa.

38. A method for replacing or reinforcing bone in vivo, comprising:

(A) providing a viscous component;

(B) providing a plurality of biodegradable inclusions, wherein the inclusions comprise polymers;

(C) combining the viscous component and the plurality of inclusions to produce the composite material; and

(D) applying the composite material in vivo to replace or reinforce bone.

39. The method of claim 38, wherein the viscous component comprises an aqueous-based composition or a polymer.

40. The method of claim 39, wherein the polymer comprises at least one polymer selected from the group consisting of poly(l-lactic acid), poly(d l-lactic acid), poly(glycolic acid), poly(lactic-co-glycolic acid), poly(paradioxanone), poly(dl-glycolic acid), poly(propylene fumarate), oligo (PEG fumerate), poly(ethyleneglycol), poly(caprolactone), poly(hydroxybutyrate), poly(hydroxy valerate), poly(SA-HDA anhydride), poly(orthoesters), poly(phosphazenes), and copolymers of dl-lactic acid and dl-glycolic acid.

41. The method of claim 38, wherein the inclusions comprise at least one polymer selected from the group consisting of poly(paradioxanone), poly(dl-lactic acid), poly(dl-glycolic acid), poly(propylene fumarate), oligo (PEG fumerate), copolymers of dl-lactic acid and dl-glycolic acid, and mixtures thereof.

42. The method of claim 38, wherein the bone replacement material is applied in vivo by injection.

43. The method of claim 42, wherein the bone replacement material is allowed to cure after injection.

44. The method of claim 38, wherein the bone replacement material is applied in vivo by a molding process.

45. The method of claim 38, wherein step (C) further comprises combining therapeutic agents with at least one of the inclusions or the viscous component.

46. The method of claim 38, wherein step (D) further comprises removing the inclusions from the bone replacement material.

47. The method of claim 46, wherein the inclusions are removed by biodegradation.

48. The method of claim 38, wherein the bone replacement material has between about 30 and 80 percent porosity.

49. The method of claim 38, wherein the bone is replaced in vertebroplasty and kyphoplasty applications.